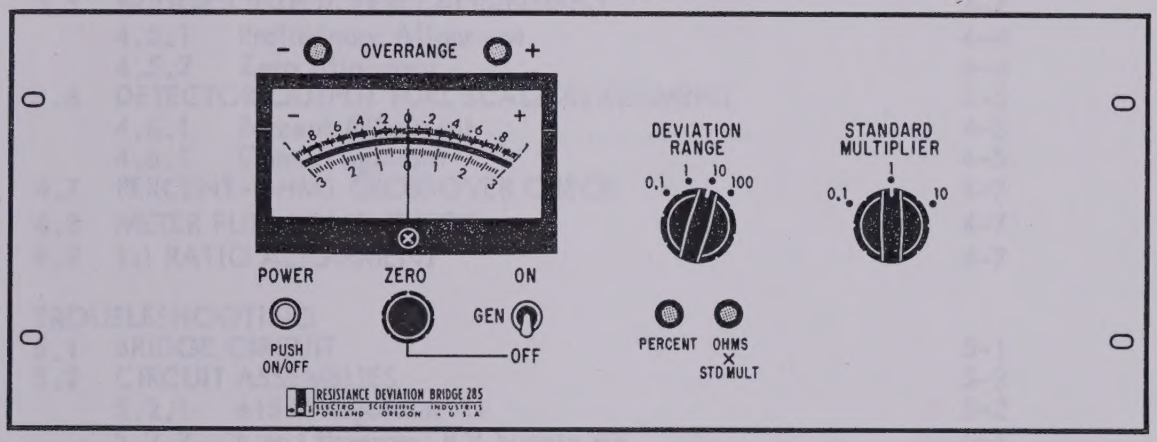
MAINTENANCE MANUAL
JANUARY 1971

MODEL 285

RESISTANCE DEVIATION BRIDGE



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SECTION I
INTRODUCTION

1.1 DESCRIPTION

The Model 285 Resistance Deviation Bridge is an active-arm device which measures and displays the unknown resistor's deviation from the setting of the decade standard. There are four full-scale deviation ranges, 100%, 10%, 1%, and 0.1%, and three bridge ratios, x10, x1, and x0.1, all selectable from the front panel. Above R_{std} = 100 Ω the Model 285 registers the deviation of the unknown in percent; below 100 Ω it reads the deviation in OHMS x STD MULT. This crossover is indicated automatically by a front panel light.

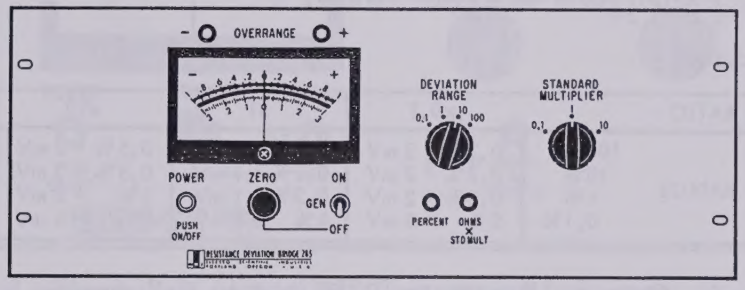


Figure 1-1. Model 285 Resistance Deviation Bridge

1.2 SPECIFICATIONS

Multiplier Ratios: x0.1, x1 and x10.

Ratio Accuracy

x1 Ratio: ±20 ppm initial, ±50 ppm for 2 years.
x0.1, x10 Ratio: ±0.01%.

Deviation Ranges

Percent: ±100, ±10, ±1, ±0.1.
Ohms x Std Mult: ±100, ±10, ±1, ±0.1.

Bridge Output Voltage: 1 volt at meter full scale.

Output Overrange: 7 x full scale on 3 lower ranges.

Analog Voltage Accuracy:

RATIO		x0.1	x1	x10
RANGE	100%	0.2% + 2 mV	0.1% + 1 mV	0.5% + 2 mV
	10%	0.2% + 2 mV	0.1% + 1 mV	0.5% + 2 mV
	1%	0.5% + 2 mV	0.2% + 1 mV	1% + 2 mV
	0.1%	5% + 5 mV	1% + 5 mV	5% + 5 mV

Bridge Response Speed: Output will settle to ±0.1% in 1 ms for unknowns less than 1 MΩ and 1 ms/MΩ for unknowns greater than 1 MΩ.

Percent-Ohms Crossover: Automatically indicated by front panel light. For R_{std} greater than 100 Ω, deviation is read in percent.

Voltage at Zero Deviation or Current for Unknown x0.1 Ratio: 0.2 V or 20 mA
x1 Ratio: 2 V or 20 mA
x10 Ratio: 2 V or 2 mA

Dimensions: Height 7 in. (17.8 cm), Width 19 in. (48.25 cm), Depth 12.5 in. (31.8 cm). Allow 5 in. additional depth for cable clearance.

SECTION II

CONTROLS AND CONNECTORS

2.1 FRONT PANEL CONTROLS AND INDICATORS

Controls and indicators on the bridge are shown in Figure 2-1.

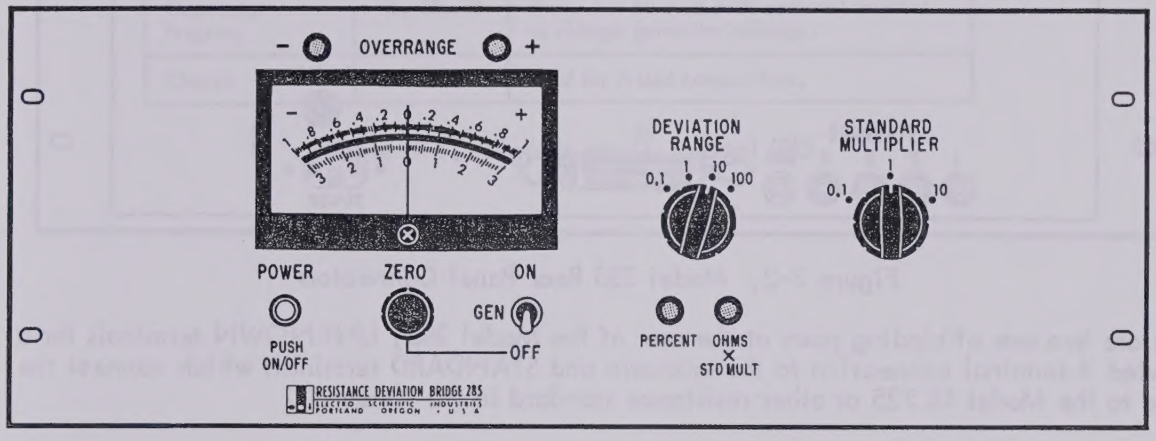


Figure 2-1. Model 285 Controls and Indicators

POWER ON/OFF pushbutton controls power to the bridge. Lamp is lit when power is on.

GEN ON OFF toggle switch controls application of voltage to the standard. It should be left in the ON position, except when making a zero test.

STANDARD MULTIPLIER dial selects the desired bridge ratio, 0.1, 1, or 10. For normal use it is usually left on 1.

DEVIATION RANGE dial selects the desired bridge deviation range, 0.1%, 1%, 10% or 100%.

PERCENT and OHMS x STD MULT lamps indicate in which units the meter should be read. PERCENT lamp lights for standard resistances greater than 100 Ω on all bridge ratios. OHMS x STD MULT lamp lights automatically for all standard resistances less than 100 Ω.

ZERO knob establishes an initial zero on the meter for the more sensitive ranges. It is used with the GEN switch OFF.

The meter display indicates the magnitude of difference between the standard and the unknown. The units of difference are determined by reading the dials and indicators to the right of the meter.

Two OVERRANGE lamps indicate whether the system is inside or outside the linear range of the bridge. When either the + or - lamp is lit, the meter will usually register an incorrect deviation of 0. If the system settings or the unknown resistor are inside the bridge's overrange capabilities, the lamps will remain unlit.

2.2 REAR PANEL CONNECTORS

Rear Panel connectors of the Model 285 are shown in Figure 2-2.

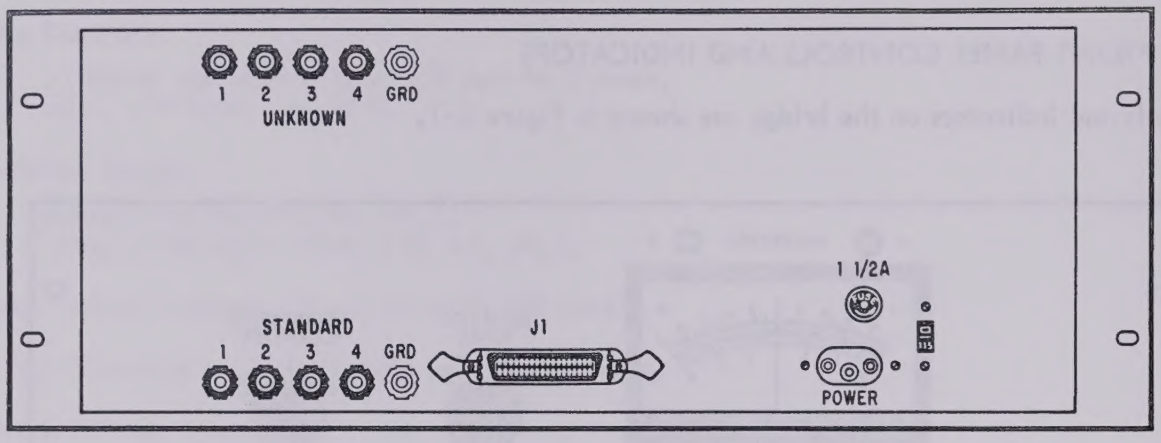


Figure 2-2. Model 285 Rear Panel Connectors

There are two sets of binding posts at the rear of the Model 285, UNKNOWN terminals for a grounded 4 terminal connection to the unknown and STANDARD terminals which connect the bridge to the Model RS 725 or other resistance standard in the system.

There is also a power socket, a line voltage selector switch and a 1 1/2A fuse.

Connector J1 is a 36-pin connector. It provides pin connections for interfacing with the Model 1410A Limits Comparator and other readout devices. The pin connections are shown in Figure 2-3. The functions available are indicated in Table 2-1.

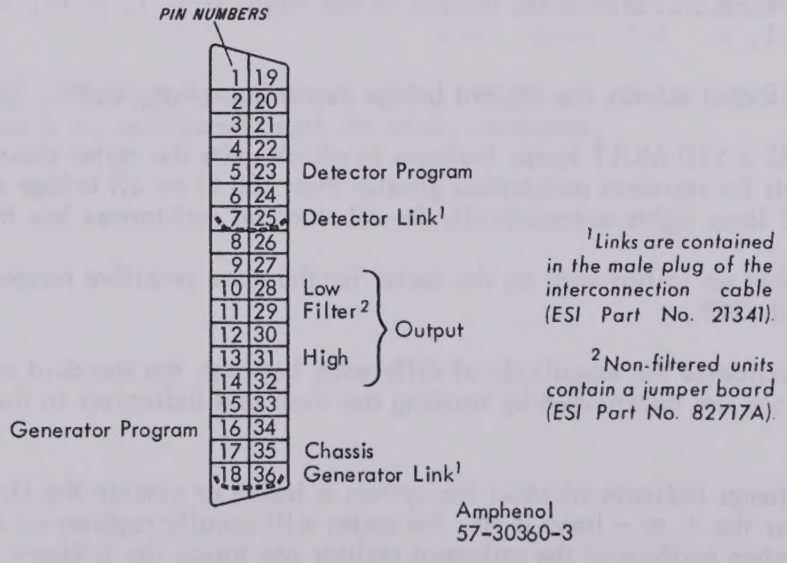


Figure 2-3. Connector J1, Model 285

FUNCTION	TERMINALS	COMMENTS
Bridge Output	28 and 31	This is low-impedance voltage proportional to deviation of unknown resistor.
Filtered Output	28 and 29	Optional; for units ordered with 60 Hz integrating filter.
Detector Program	7, 23, 25	These can be used with external resistors to change detector sensitivity.
Generator Program	16, 18, 36	These can be used with external resistors to change generator voltage.
Chassis	35	Used for shield connections.

Table 3-1. Signals on J1, Model 285

SECTION III

THEORY OF OPERATION

3.1 BRIDGE CIRCUIT

A four-terminal, active-arm comparison bridge circuit minimizes errors from lead and contact resistances. This is accomplished by making two connections to each end of the unknown resistor. Lead and connection resistances are placed either in generator leads where they will have no effect, in series with the high-value internal bridge arms where they will have an insignificant effect, or in series with the bridge yoke shunt where their effect can be eliminated by the proper yoke ratio.

Figure 3-1 shows the simplified bridge diagram.

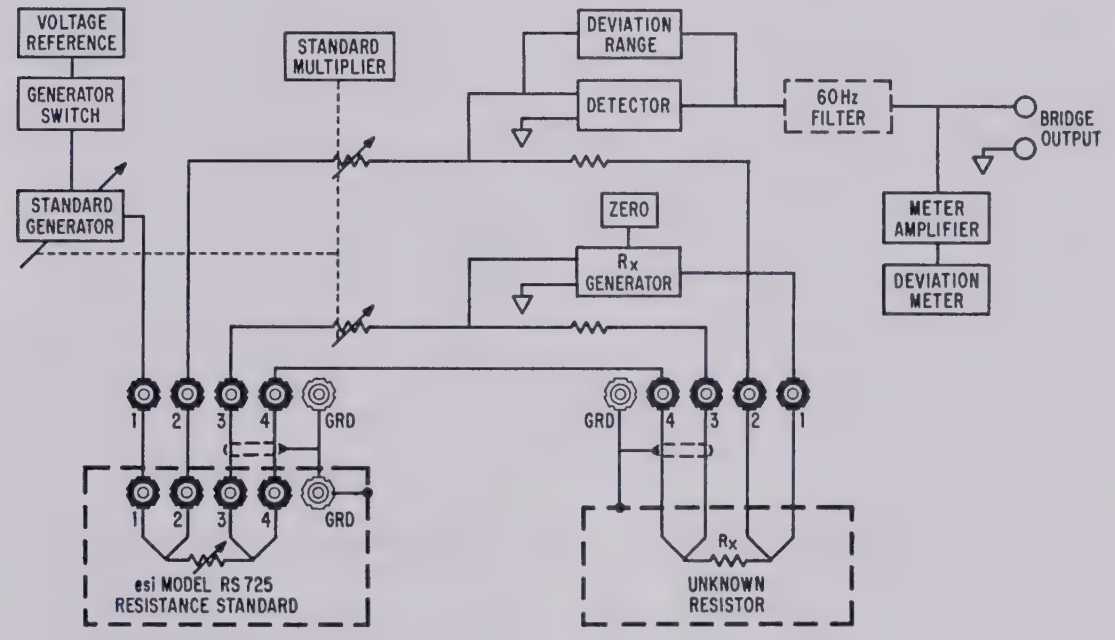


Figure 3-1. Simplified Bridge Diagram

The standard generator maintains constant voltage (percent deviation) or constant current (ohms deviation) in the standard resistor. A separate R_X generator is connected such that all current passing through the standard resistor also passes through the unknown resistor. The voltage difference is measured by the detector circuits. The standard multiplier control sets the bridge ratio and voltage-current of the standard generator. The deviation range control sets detector sensitivity. These two controls set the bridge output scale factor (±1 volt at meter full scale). A 60 Hz integrating filter is an option used for systems where line frequency pickup is a problem. The deviation meter is driven by its own amplifier.

3.2 GUARDING

The bridge is guarded so that high-resistance leakage paths for both the unknown and standard resistors are intercepted. The chassis is used as the guard shield. Leakage resistances are shunted across low-resistance internal bridge arms or the detector. Guarding of a three-terminal unknown resistor can be accomplished by connecting the bridge chassis to its leakage intercept terminal. This guarding permits accurate measurement of high-value resistors even in humid environment.

SECTION IV

ALIGNMENT PROCEDURE

4.1 EQUIPMENT REQUIREMENTS

Minimum use specifications will aid in the selection of alternate equipment if the recommended equipment is not available. Be sure alternate items meet the requirements.

Item	Minimum Use Specifications	Recommended Equipment
Digital Voltmeter	Accuracy: 0.05% Readout: 4 1/2 digits	Fluke Model 8100A
Resistance Standards (2)	Type: Four-terminal Range: 0.1 Ω to 1 MΩ in 0.1 Ω steps Accuracy: 50 ppm	ESI Model RS 925
Patch Plug	Type: 36-pin male connector with test point connections to pins 28 (grd), 29 (filter output) and 31 (detector output) and 2 jumpers, one from pin 7 to pin 25 and one from pin 18 to pin 36.	Amphenol No. 57-30360-3

4.2 PRELIMINARY OPERATIONS

1.	If necessary adjust mechanical meter zero with screw on front panel.	Unit should be off.
2.	Remove dust cover and verify that all circuit boards are seated properly.	
3.	Place unit so that front panel faces operator.	This is the orientation to which all directions hereafter shall refer.

NOTE: *If patch plug is not used, plug in connector to J1. Bridge will not operate without links contained in this plug (see Figure 2-3).*

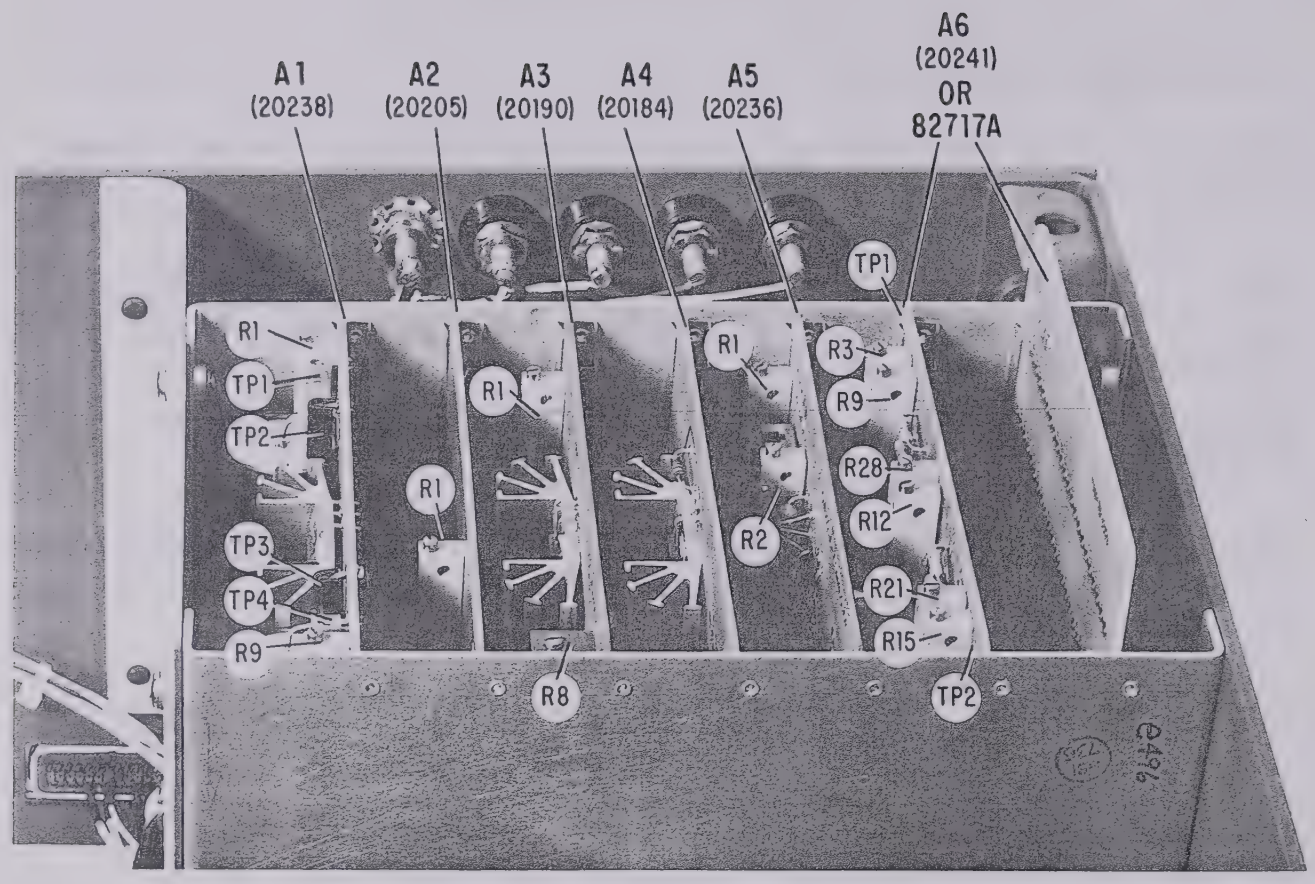


Figure 4-1. Test Point and Trimmer Locations

4.3 ±15-VOLT POWER SUPPLY ALIGNMENT

1.	Plug in unit and press POWER ON/OFF pushbutton.	Lamp is lit when power is on.
2.	Connect DVM to rear test points of ±15 V regulator assembly A1 (Part No. 20238), high side to red, low to black, and adjust rear trimmer R1 if necessary.	Black test point is common. DVM should read ±15 V ±0.75 V. See Figure 4-1 for test point and trimmer locations.
3.	Connect DVM to front test points, high side to red, low to black and adjust front trimmer R9 if necessary.	DVM should read + 15 V ±0.75 V.

4.4 (OPTIONAL) 60 Hz INTEGRATING FILTER ALIGNMENT

1. Set Model 285 controls as follows:

   DEVIATION RANGE to 10.
   STANDARD MULTIPLIER to 1,
   GEN to ON.

2. Connect one resistance standard to corresponding Model 285 STANDARD terminals, other standard to corresponding Model 285 UNKNOWN terminals.

3. Set each standard to 10 kilohms.

4. Connect DVM to patch plug, high side to detector output (pin 31), low to ground (pin 28).

5. Adjust front-panel ZERO knob for DVM reading of 0.0000 V.

6. Move high lead of DVM to rear green test point TP1 on filter assembly A6 (Part No. 20241) and adjust trimmer R9 for DVM reading of 0 V ±0.5 mV.

   See Figure 4-1.

7. Move high lead of DVM to front green test point TP2 and adjust trimmer R21 for DVM reading of 0 V ±0.5 mV.

8. (Optional, for meter hold function) Turn unit on its side and ground pins J and H on filter board. Adjust trimmer R28 until DVM reading is stable and changes less than 2 mV/s.

   See Paragraph 5.2.6

9. Move high lead of DVM to patch plug detector output (pin 31).

   This and the following steps adjust the filter output.

10. Set "unknown" standard to 20 kilohms, then adjust it for DVM reading of 10 V ±1 mV.

11. Short pin H on filter board to ground. Move high lead of DVM to patch plug filter output (pin 29) and adjust trimmer R3 for DVM reading of 10 V ±2 mV.

12. Short pin J to ground and adjust trimmer R15 for DVM reading of 10 V ±2 mV.

4.5 BRIDGE OUTPUT ZERO ALIGNMENT

4.5.1 Preliminary Alignment

1. Set Model 285 controls as follows:

   DEVIATION RANGE to 10
   STANDARD MULTIPLIER to 1
   GEN to OFF

2. Set "unknown" standard to 100 kilohms, "standard" standard to 10 kilohms.

   Hereafter these standards will be referred to as unknown and standard.

3. Connect DVM to Model 285, high side to UNKNOWN terminal 2, low to ground.

4. Verify that PERCENT lamp is lit. If necessary, adjust rear trimmer R1 on voltage-current amp assembly A3 (Part No. 20190) until OHMS x STD MULT lamp just goes out and PERCENT lamp just lights.

   DVM should read 0 V ±0.5 mV.

4.5.2 Zero Alignment

1. Set Model 285 controls as follows:

   DEVIATION RANGE to 100
   STANDARD MULTIPLIER to 1
   GEN to OFF.

2. Set unknown and standard to 10 kilohms each.

3. Connect DVM to patch plug, high side to detector output (pin 31) low to ground.

   DVM should read 0 V ±0.5 mV.

4. Set DEVIATION RANGE switch to 1.

   DVM should read 0 V ±0.5 mV.

5. If readings are out of tolerance, adjust ZERO knob for correct DVM reading, then set DEVIATION RANGE switch back to 100 and adjust rear trimmer R1 on det and overrange comparator assembly A5 (Part No. 20236) for correct DVM reading.

6. Repeat steps 4 and 5 if necessary until DVM reads correctly on both ranges.

4.6 DETECTOR OUTPUT FULL SCALE ALIGNMENT

4.6.1 Percent Alignment

1. Set Model 285 controls as follows:

   DEVIATION RANGE to 10
   STANDARD MULTIPLIER to 1
   GEN to ON

2. Set unknown and standard to 10 kilohms each

3. Connect DVM to patch plug, high side to detector output (pin 31), low to ground.

4. Adjust ZERO knob for DVM reading of 0 V ±0.5 mV.

5. Set unknown to 11 kilohms. If reading is out of tolerance, adjust trimmer R1 on E or I program, 8 V supply assembly A2 (Part No. 20205).

   DVM should read 1 V ±0.5 mV.

6. Set STANDARD MULTIPLIER switch to 10 and unknown to 100 kilohms.

7. Adjust ZERO knob for DVM reading of 0 V ±0.5 mV.

8. Set unknown to 110 kilohms. If reading is out of tolerance, adjust front trimmer R8 on voltage-current amp assembly A3 (Part No. 20190.

   DVM should read 1 V ±0.5 mV.

9. Repeat steps 1 through 5.

4.6.2 Ohms Alignment

1. Set Model 285 controls as follows:

   DEVIATION RANGE to 10
   STANDARD MULTIPLIER to 10
   GEN to ON

2. Set unknown to 900 ohms and set standard to 90 ohms.

3. Connect DVM to patch plug, high side to detector output (pin 31), low to ground.

4. Adjust ZERO knob for DVM reading of 0 V ±0.5 mV.

5. Set unknown to 1 kilohm. If reading is out of tolerance, adjust rear trimmer R1 on voltage-current amp assembly A3 (Part No. 20190).

DVM should read 1 V ±0.5 mV.

6. Set unknown to 90 ohms and STANDARD MULTIPLIER switch to 1.

7. Adjust ZERO knob for DVM reading of 0 V ±0.5 mV.

8. Set unknown to 100 ohms.

DVM should read 1 V ±1.0 mV.

4.7 PERCENT-OHMS CROSSOVER CHECK

1. Set Model 285 controls as follows:

   DEVIATION RANGE to 10
   STANDARD MULTIPLIER to 1
   GEN to ON

2. Set unknown and standard to 100 ohms each. — PERCENT lamp should be lit.

3. Reduce standard by 0.1 ohms. — OHMS x STD MULT lamp should light and PERCENT lamp go out. Tolerance is ±0.2 ohms.

4.8 METER FULL SCALE CHECK

1.	Set Model 285 controls as follows: DEVIATION RANGE to 10 STANDARD MULTIPLIER to 1 GEN to ON.	
2.	Set unknown and standard to 10 kilohms each and zero Model 285 meter with ZERO knob.	
3.	Set unknown to 11 kilohms. If reading is out of tolerance, adjust front trimmer R2 on det and overrange comparator assembly A5 (Part No. 20236).	Model 285 meter should read full scale (±1/2 division).
4.	Set unknown to 9 kilohms.	DVM should read full scale (±1/2 division) in opposite direction.

4.9 1:1 RATIO ALIGNMENT

1. Set Model 285 controls as follows:

   DEVIATION RANGE to 1
   STANDARD MULTIPLIER to 1
   GEN to OFF.

2. Set unknown and standard to 10 kilohms each.

3. Connect DVM to patch plug, high side to detector output (pin 31), low to ground.

4. Adjust ZERO knob. — DVM should read 0 V ±0.5 mV.

5. Turn generator on and adjust RATIO trimmer R12 (located to the left of STANDARD MULTIPLIER switch) for DVM reading of 0 V ±1 mV. — This trimmer is not shown in Figure 4-1. See bridge circuit diagram, Figure 5-1.

6. Turn generator off and repeat steps 4 and 5 readjusting RATIO trimmer R12 if necessary.

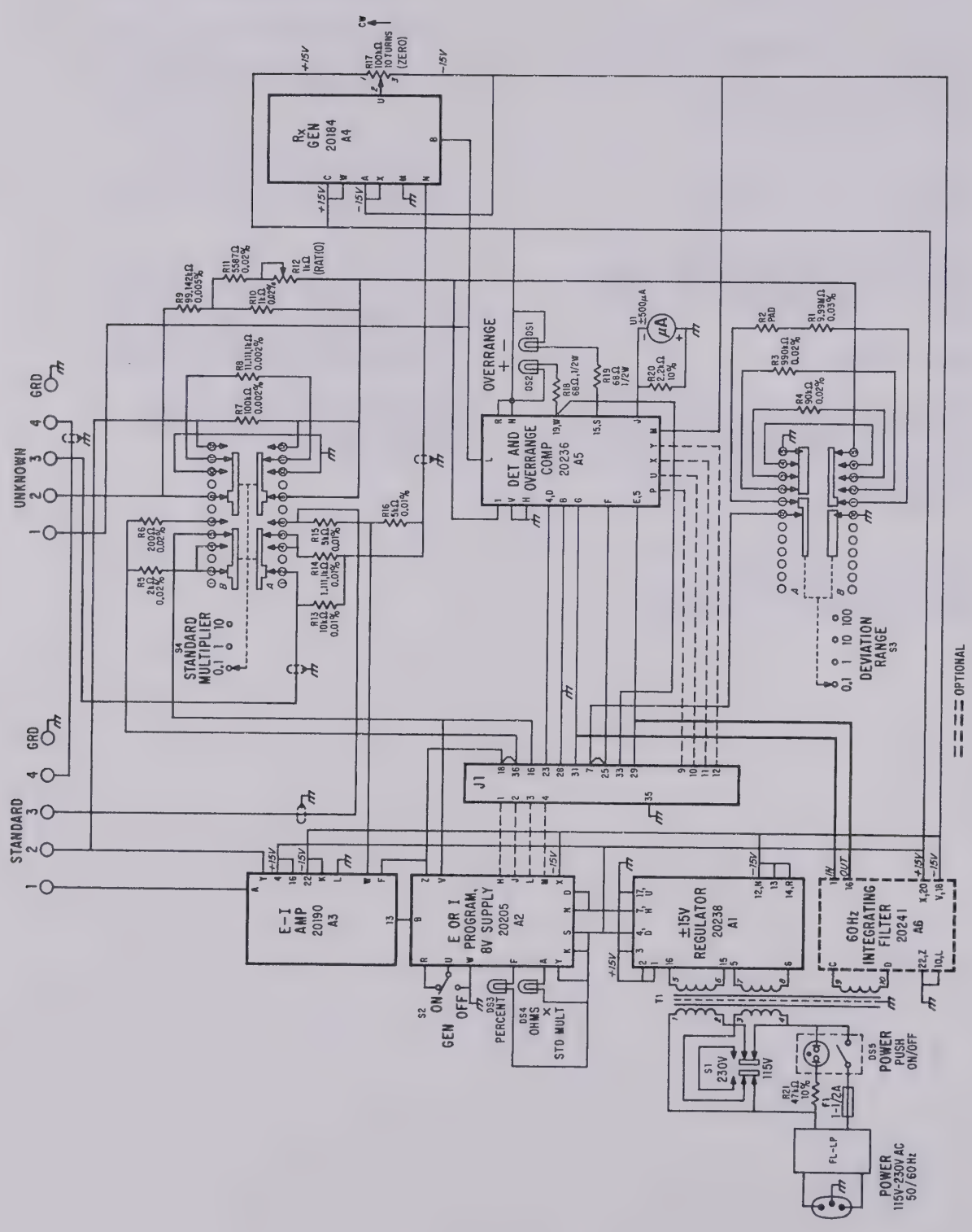


Figure 5-1. Bridge Circuit Diagram

SECTION V
TROUBLESHOOTING

The following functional descriptions are provided as an aid to troubleshooting.

5.1 BRIDGE CIRCUIT

Power for the bridge is supplied by the ±15 V regulator assembly A1 (Part No. 20238).

The standard generator, consisting of the E or I program, 8 V supply assembly A2 (Part No. 20205) and the voltage-current amp assembly A3 (Part No. 20190), maintains constant voltage (percent deviation) or constant current (ohms deviation) in the standard resistor. The STANDARD MULTIPLIER switch S4 selects the resistor which programs the standard generator for the proper voltage or current: R5 for x0.1 and x1 multipliers, R6 for x10.

The STANDARD MULTIPLIER switch also selects the proper bridge and yoke ratio resistors. R7 through R11 and trimmer R12 are the bridge ratio resistors; R12 (RATIO) sets the x1 ratio for zero error. The yoke ratio resistors are R13 through R16.

A separate R_X generator A4 (Part No. 20184) is connected so that all current passing through the standard resistor also passes through the unknown resistor. The voltage difference is measured by the detector circuits, the det and overrange comparator assembly A5 (Part No. 20236) and optional 60 Hz integrating filter assembly A6 (Part No. 20241). R17 (ZERO) is the front-panel meter zero trimmer.

The DEVIATION RANGE control S3 sets the detector sensitivity by selecting the appropriate resistance, R1 and R2 or R3 or R4 or a 10 kilohm equivalent resistance network, R17 through R19 on the det and overrange comparator assembly (Part No. 20236). The detector output at the rear of the unit (J1, pin 31) provides ±1 volt at meter full scale. The deviation meter U1 is driven by its own amplifier AR1 on the det and overrange comparator assembly A5 (Part No. 20236).

5.2 CIRCUIT ASSEMBLIES

5.2.1 ±15 V Regulator A1

ESI Part No. 20238

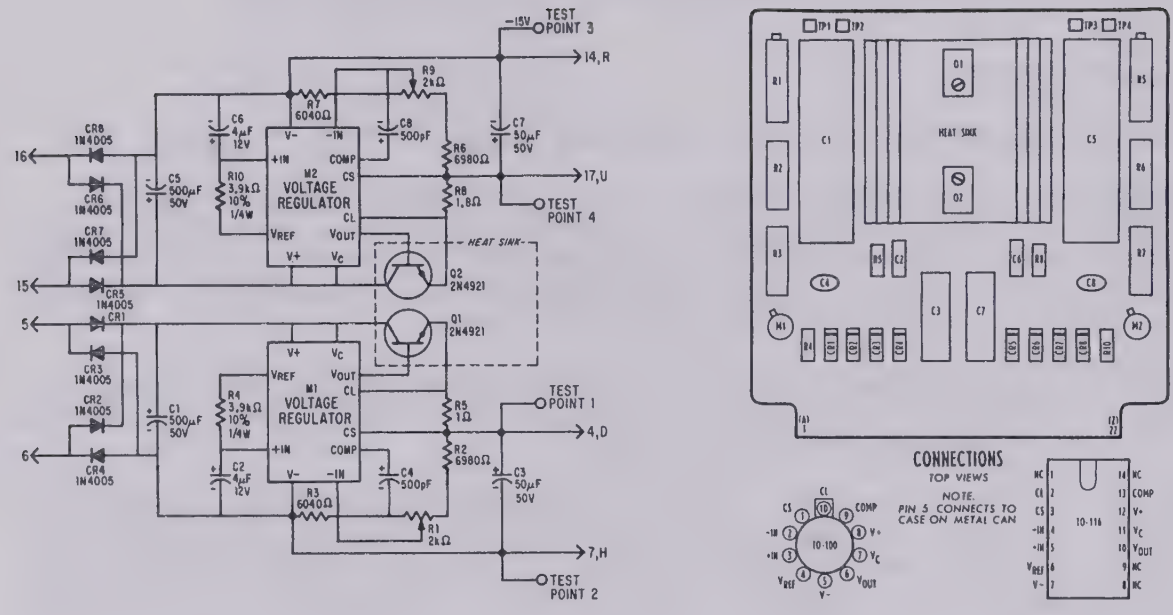


Figure 5-2. ±15 V Regulator Assembly (A1)

This assembly has two identical 15 volt regulators. The plus side of one circuit and the minus side of the other are tied to ground, making a ±15 volt source to supply power for the operational amplifiers and logic in the bridge.

Because the two circuits are identical, only one of them will be detailed here. The source of the unregulated ac voltage, the transformer winding, connects to the circuit on pins 15 and 16 (pins 5 and 6 for the other circuit). The plus side of the regulated dc output connects to pin 17 (pin 4 for the other circuit). The minus side of the regulated dc output connects to pin 14 (pin 7 of the other circuit).

Diodes CR5, CR6, CR7, and CR8 rectify the unregulated ac voltage.

Capacitor C5 filters the rectified ac voltage. The unregulated dc voltage on capacitor C5 is the source of current for the output of the circuit and also is used to operate the integrated circuit voltage regulator M2. The value of the unregulated dc voltage, depending on line voltage, is approximately 20 to 25 volts.

The integrated circuit voltage regulator M2 has a voltage reference, an error amplifier, a series pass transistor and a provision for current limiting. An additional series pass transistor Q2 is used in the 15 volt regulator because the transistor internal to the integrated circuit does not have sufficient current or power capability.

Capacitor C6 filters the internal voltage reference of M2 and reduces the noise in the output. If C6 has low internal resistance, the output of the 15 volt regulator circuit will be low.

Resistors R6, R7 and R9 set the output voltage. R9 is a trimmer and is used to set the output to exactly 15 volts.

Resistor R10 reduces drifts in the output of the 15 volt regulator caused by changing bias currents in M2. Errors in the value of R10 will probably have small effect on the value of the output voltage.

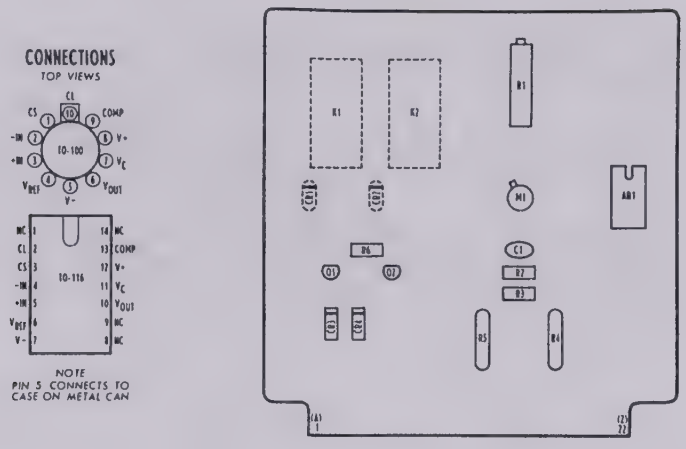
Capacitor C8 stabilizes the error amplifier in M2. If C8 were faulty it could cause circuit oscillation or output voltage errors.

Resistor R8 sets the current limiting level of the output. When the voltage drop across R8 increases to approximately 0.65 volts, the output will current limit.

Capacitor C7 is the final output filter. An open capacitor could result in excessive output noise or ripple. A capacitor with low internal resistance could result in reduced current available to the load. The voltage on C7 should be 15 volts and should have less than 100 millivolts peak-to-peak ripple.

5.2.2 E or I Program, 8 V Supply A2

ESI Part No. 20205



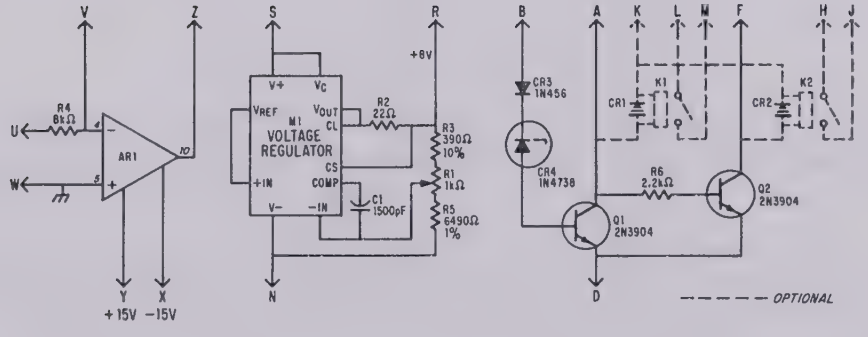


Figure 5-3. E or I Program, 8 V Supply Assembly (A2)

This assembly consists of three separate circuits: a constant voltage generator, a regulated voltage source, and an indicator lamp and relay driver.

AR1 is the constant voltage generator. It is an operational amplifier which, in conjunction with the regulated 8 V supply, generates a constant voltage for the voltage-current amp assembly A3 (Part No. 20190).

The STANDARD MULTIPLIER switch on the front panel selects a resistor of 2 kilohms or 200 ohms, to be placed between the output of AR1 (pin Z) and the inverting input of AR1 (pin V). When the GEN switch is in the OFF position, pin U is grounded. This produces zero volts output at pin Z and zero volts output from the voltage-current amp assembly. When the GEN switch is in the ON position, pin U is connected to the regulated 8 V supply. The combination of R4 (8 kilohms) and the resistor connected between pins Z and V (2 kilohms or 200 ohms) produces an output voltage at pin Z of 2 volts or 0.2 volts respectively. There are provisions for external voltage programs.

The regulated voltage source is composed of M1, R1, R2, R3, R5, and C1. The power source is the ±15 V regulator assembly A1 (Part No. 20238). Pin N is connected to the power supply ground and pin S is connected to its + 15 V.

M1 is an integrated circuit which contains a voltage reference, an error amplifier, a series pass transistor, and provision for current limiting. R1, R3, and R5 set the output voltage. R1 is a trimmer used for fine adjustment of the output voltage (8 V) which appears at pin R and is used as a voltage reference by AR1 to generate the desired program voltages. R2 sets the current limiting level of the output. When the voltage drop across R2 exceeds 0.65 volts, the output will current limit. C1 stabilizes the error amplifier in M1. If C1 were faulty, it could cause errors in the output voltage or circuit oscillation.

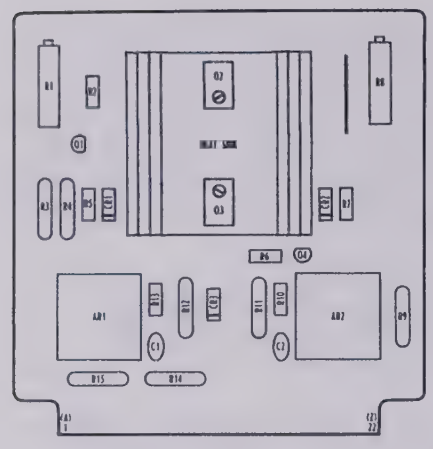
The indicator lamp and relay driver operates the PERCENT and OHMS x STD MULT lights on the front panel. When AR2 of the voltage-current amp assembly A3 (Part No. 20190) is operating in a constant voltage mode, its output on pin 13 reaches pin B of the E or I program assembly, but does not have sufficient magnitude to turn Q1 on. Since Q1 is off, its collector is quite high, making the base of Q2 also high, which turns on Q2. This lights the PERCENT lamp connected to pin F (and also operates K2 which is an optional relay).

When AR2 of the voltage-current amp assembly A3 (Part No. 20190) saturates, AR1 of the same circuit goes into the constant current mode. The output of AR2 on pin 13 goes to approximately + 12 V, which is sufficient to break down Zener diode CR4, bringing the base of Q1 high and turning it on. This lights the OHMS x STD MULT lamp (and also operates optional relay K1). When Q1 turns on, the base of Q2 is pulled down low, and Q2 turns off. This causes the PERCENT lamp to go out (and optional relay K2 to open).

CR3 protects the base junction of Q1 from reverse bias damage. CR1 and CR2 are optional transient suppression diodes.

5.2.3 Voltage-Current Amp A3

ESI Part No. 20190



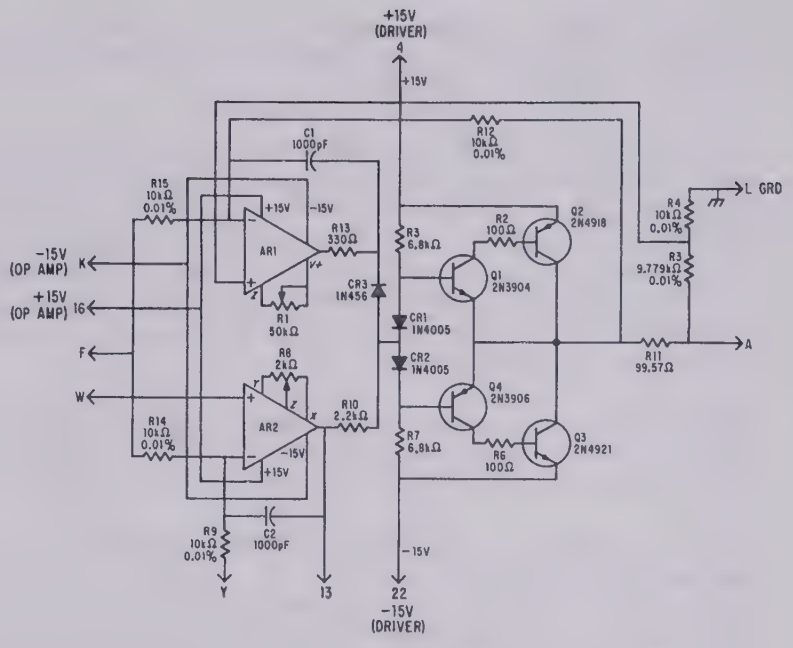


Figure 5-4. Voltage-Current Amp Assembly (A3)

This assembly supplies constant precision voltages or currents to the standard resistor decades of the Model 503A.

Pin F receives a constant voltage from the E or I program, 8 V supply assembly (Part No. 20205). AR1, the constant current amplifier, is normally off. AR2, the constant voltage amplifier, is normally in control. The output of AR2 is fed into the power amplifier Q1 through Q4, which is capable of great accuracy because of the total feedback and control of AR2. The output of this power amplifier, pin A, is connected to STANDARD terminal 1. R9 is connected to STANDARD terminal 2. In a normal bridge operation, these two binding posts will connect to the same side of the standard resistor (Model RS 725 in the Model 503A system). Their connection completes the feedback loop of AR2, with R9 and R14 of equal value (10 kΩ), and gives an overall gain of 1.

If the current through R11 produces an IR drop across R11 greater than the input voltage at pin F, AR2 saturates and loses control. AR1 takes over control and programs the power amplifier for constant current. R12, R15, R3 and R4 provide an accurate differential measurement of R11's voltage.

As AR2 saturates, its output on pin 13 goes to approximately + 12 volts. This voltage is sensed at pin B of the E or I program assembly (Part No. 20205) and causes Q1 of that assembly to turn off the PERCENT lamp and Q2 to turn on the OHMS x STD MULT lamp.

R1 and R8 are zero controls for AR1 and AR2. C1 and C2 provide high-frequency rolloff for these amplifiers. R10 and R13 are current limiting resistors for AR1 and AR2. CR3 gives primary control to AR2. R2, R3, R6, R7, CR1 and CR2 provide bias control for the power amplifier Q1 through Q4.

5.2.4 R_X Generator A4

ESI Part No. 20184

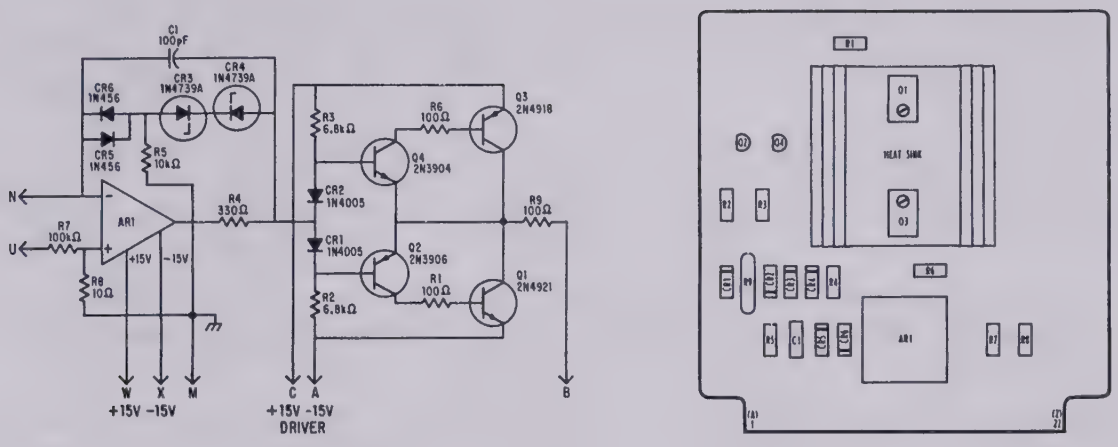


Figure 5-5. R_X Generator Assembly (A4)

The R_X generator senses the current flowing through the standard resistor and drives an equal amount of current through the unknown resistor.

The assembly consists of an FET-input operational amplifier AR1 and a discrete-component current amplifier CR1, CR2, R1, R2, R3, R6, R9 and Q1 through Q4. The input is on pin N. Pin U is connected to the tap of the front-panel ZERO control and the voltage at this tap is divided by R7 and R8 to provide offset compensation to the non-inverting (plus) input of AR1. CR3 through CR6 and R5 provide overload protection for AR1. C1 attenuates higher frequency signals. The output of the current amplifier is pin B. This output is fed back through the bridge circuit to pin N to assure accurate gain.

5.2.5 Det and Overrange Comparator A5

ESI Part No. 20236

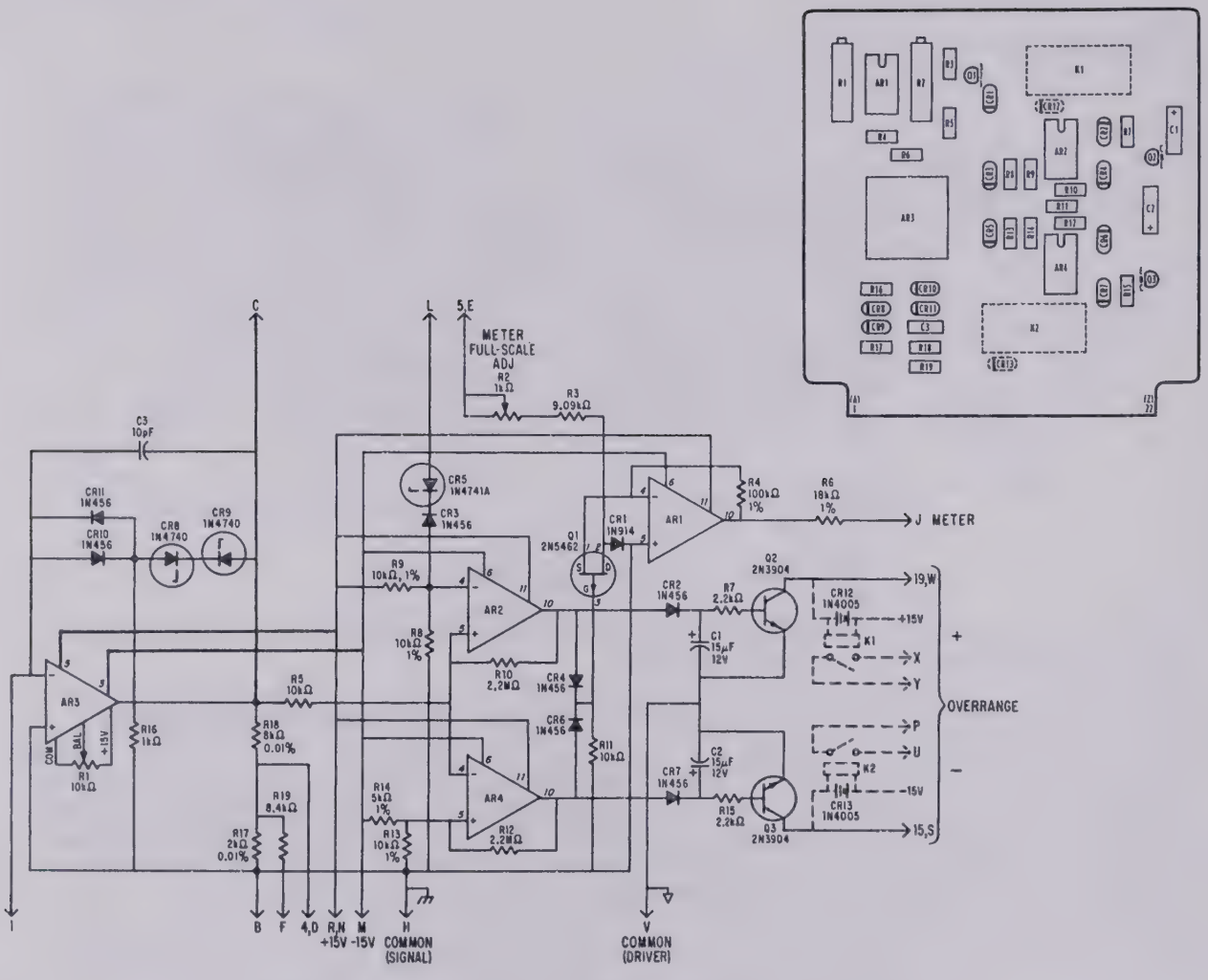


Figure 5-6. Det and Overrange Comparator Assembly (A5)

This assembly amplifies the bridge output, drives the panel meter and provides overrange protection for the meter and external devices.

The input on pin 1 is amplified by AR3. The gain for AR3 is selected by the DEVIATION RANGE switch The network composed of CR8 through CR11 and R16 provides overload protection for AR3. CR10 and CR11 are low-leakage diodes which conduct only when CR8 or CR9 reach Zener voltage. C3 provides high-frequency rolloff.

The output of AR3 is fed to pin C and through R5 to the non-inverting (plus) input of AR2 and the inverting (minus) input of AR4. From pin C the signal is fed to pin 1 of the 60 Hz integrating filter A6 (Part No. 20241). The output of the filter, pin 16, is fed back to the detector assembly on pins 5 and E. If the unit does not contain the filter option, a dummy board (Part No. 82717A) which connects pin 1 to pin 16, is placed in its socket.

The signal arriving at pin 5 passes through R2, R3 and Q1 to reach the inverting input of AR1, which drives the panel meter after passing through R6. The output of AR1 is pin J. R4 is for feedback on AR1 and R2 is for the meter full-scale adjustment. When the voltage at its gate reaches approximately + 10 volts, Q1 acts as a switch to turn off the meter amplifier. CR1 keeps the drain of Q1 clamped to a low value if the input is positive and Q1 is turned off.

AR2 and AR4 have normal outputs of about -14 volts each and are operated at very high gain. The inverting input of AR2, connected to the divider formed by R8 and R9, is approximately + 7.5 volts. The non-inverting input of AR4, connected to the divider formed by R13 and R14, is approximately -10 volts.

If the output of AR3 were to exceed the + 7.5 volts on the inverting input of AR2, AR2 would saturate in the positive direction, causing an output of + 14 volts. This voltage, passing through CR4, would cause Q1 to turn off, deactivating the meter circuit. It would also bring the base of Q2 high, turning on the + OVERRANGE panel lamp.

If the output of AR3 were to exceed -10 volts, AR4 would saturate and its output rise to + 14 volts. This voltage, passing through CR6 would turn off Q1 as before and raise the base of Q3 to turn on the - OVERRANGE panel lamp.

If the R_X generator assembly A4 (Part No. 20184) should saturate, its output on pin B (detector assembly input on pin L) would cause AR2 to saturate to + 14 volts, lighting the + OVER-RANGE lamp.

R10 and R12 provide positive feedback to AR2 and AR4 to give some hysteresis effect with overload.

R7, C1 and R15, C2 give additional time delay for turnoff of lamp drivers Q2 and Q3.

K1, CR12 and K2, CR13 are optional overload output relays and suppression diodes.

5.2.6 60 Hz Integrating Filter A6

ESI Part No. 20241

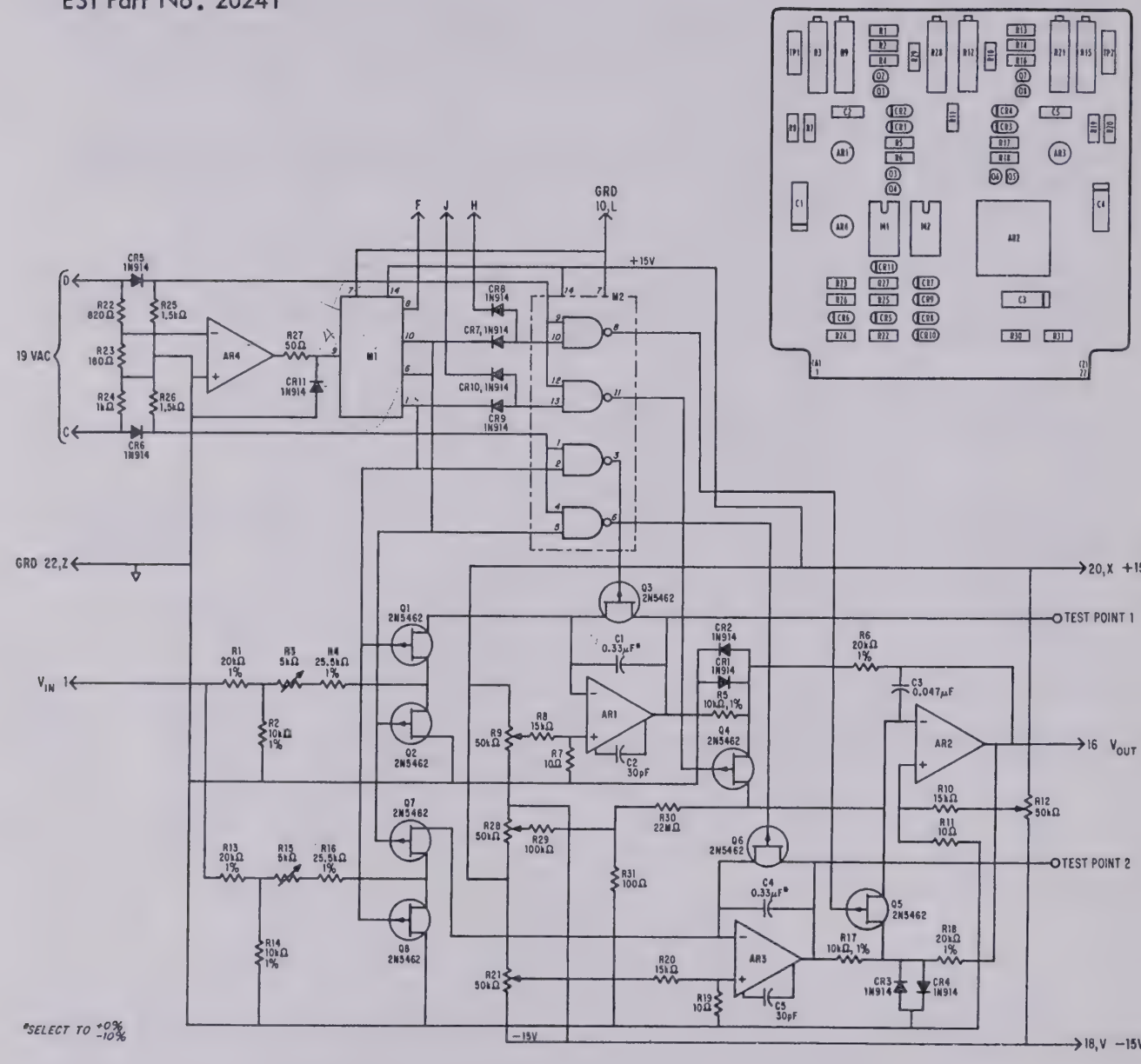


Figure 5-7. 60 Hz Integrating Filter Assembly (A6)

The 60 Hz integrating filter is used to filter out unwanted stray 60 Hz signals from the detector. It is optional on Model 503A systems designed to measure up to 10 megohms and standard on systems used to measure up to 100 megohms.

The filter is used between the preamplifier AR3 and the meter amplifier AR1 of the det and overrange comparator assembly A5 (Part No. 20236). Units not using the filter receive a special jumper board (Part No. 82717A) to connect the preamplifier and meter amplifier of the comparator.

Two power sources are required for the filter: ±15 V from the ±15 V regulator A1 (Part No. 20238) for all logic and operational amplifiers and 19 VAC from the power transformer T1 (Part No. 20234) to control and time all logic functions.

The 19 VAC is connected to pins C and D. It appears across the bridge network formed by R22 through R26 and CR5 and CR6. Approximately 1 volt appears at the input of AR4, which drives its output to about ±14 volts in the form of a 60 Hz square wave. This square wave is clipped by CR11 to produce a -0.5 V to + 14 V square wave, which is fed into the input of M1, a dual flip-flop.

Q(6) and $\overline{Q}$(1) outputs of M1 provide 30 Hz timing signals to control all functions of the filter in conjunction with the outputs of CR5 and CR6 (which provide 60 Hz timing signals).

M2 is a quad 2 input NAND gate. It combines the properly phased 60 Hz and 30 Hz signals to control the operation of the integrators AR1 and AR3.

DC voltage from the det and overrange comparator assembly A5 preamplifier is applied at pin 1 of the filter assembly. The dc signal passes into two divider networks, made up of R1 a through R4 and R13 through R16. R3 and R15 are trimmers used to set the proper level of current into each integrator so that in the allowed integration time each integrator will produce a signal level that will give an overall filter gain of +1.

After passing through the divider networks, the dc voltage is chopped by FET's Q1 and Q2 and Q7 and Q8. The FET's are driven at a 30 Hz rate by M1. While one network is being sampled, the other is being grounded.

The chopper outputs are fed into integrators AR1 and AR3, which are allowed to integrate for 1/60 second. Any 60 Hz signals or harmonics appearing on the dc input voltage will be averaged out to zero during the integration period.

The output of each integrator is then sampled alternately. Q4 samples the output of AR1 and Q5 samples the output of AR3.

Q4 and Q5 are driven by M2. The sample voltages of the integrators are fed into the minus input of AR2, which averages the two signals to produce a filtered output voltage at pin 16 equal to the input voltage at pin 1.

It should be noted that all chopping, integrating and sampling of the two channels are 180° out of phase.

Q3 and Q6 are for resetting integrating capacitors C1 and C4 respectively. They are driven by M2 for a period after each integrator has been sampled. This prepares the integrator to be integrated for another 1/60 second.

Trimmers on the assembly function as follows: R3 and R15 set the proper current to each integrator. R9 zeros input offsets of AR1. R21 zeros input offsets of AR3. R28 zeros leakage currents from Q4 and Q5. R12 zeros input offsets of AR2.

Grounding pin H disconnects AR3. Grounding pin J disconnects AR1. Grounding both pin J and H disconnects both AR1 and AR3, allowing trimmer R28 to be set for zero drift. Since disconnecting AR1 and AR3 prevents further integration or resetting, grounding of these two pins can be used for retaining meter readings (meter hold function). These pins can be wired to J1 for external access.

SECTION VI

MAINTENANCE AND REPAIR

6.1 ACCESSING COMPONENTS

Prepare a soft, clean place to set the instrument. Be sure that no projections or pointed objects will be underneath it and that there are no metal filings in the area.

To remove the Model 285 from the cabinet, remove the four mounting screws (one in each corner of the front panel), disconnect all connections to the bridge, then slide the unit out the front of the cabinet. Place on prepared surface.

To remove the dust cover, release the quarter-turn fasteners and lift it off.

6.2 PERIODIC MAINTENANCE

The following procedures should be performed approximately once a year to insure maximum accuracy and reliability from the Model 285 Resistance Deviation Bridge. If problems can be isolated to individual circuit assemblies, the defective assembly should be returned to the factory for repair or replacement. If the need for major repairs is apparent, it is recommended that the unit be sent to the factory for service. If you are unable to release the unit, the service department will be happy to furnish the necessary information and replacement parts. Unauthorized repairs, however, will invalidate the instrument warranty.

6.2.1 Visual Inspection

Inspect the outside of the unit for dial orientation and damage to connectors, binding posts and binding post caps. Check for dirt around the binding post insulators.

Inspect the interior for loose or broken connections, damaged or dirty switch or socket contacts, heat-damaged resistors and resistors touching each other or the grounded switch structure.

6.2.2 Cleaning and Lubrication

Clean the front panel with a soft, dry, lint-free cloth, being particularly careful to remove all dirt from around binding post insulators.

The only internal components that may require maintenance are the rotary switches. Carefully lubricated at the time of manufacture and protected by the instrument case, they should rarely, if ever, require maintenance. It is recommended that they be cleaned and lubricated *only* if they are not making good electrical contact. In such a case, proceed as follows:

1. Place instrument horizontally on bench, with a sheet of white paper under switch to be cleaned. Spray switch with Freon TF degreaser in aerosol can (Miller Stephenson Co. or equivalent) until no more dirt appears on paper. Drying is not necessary.
2. Lubricate with a low-conductivity oil (Viscosity Oil Co., No. 7069, available from ESI as Part No. 13500). Apply one drop to each rotor tab and one drop to the rotor ring contact, using a hypodermic needle. With a small brush, apply a dab of petroleum jelly to each switch bearing and detent mechanism. DO NOT OVERLUBRICATE.

6.3 REPAIR

6.3.1 Circuit Assembly Location

All circuit assemblies are shown in Figure 6-1, a top view of the bridge. The labels are circuit reference designators corresponding to those used in the circuit diagrams in the previous section and the Replacement Parts List in this section.

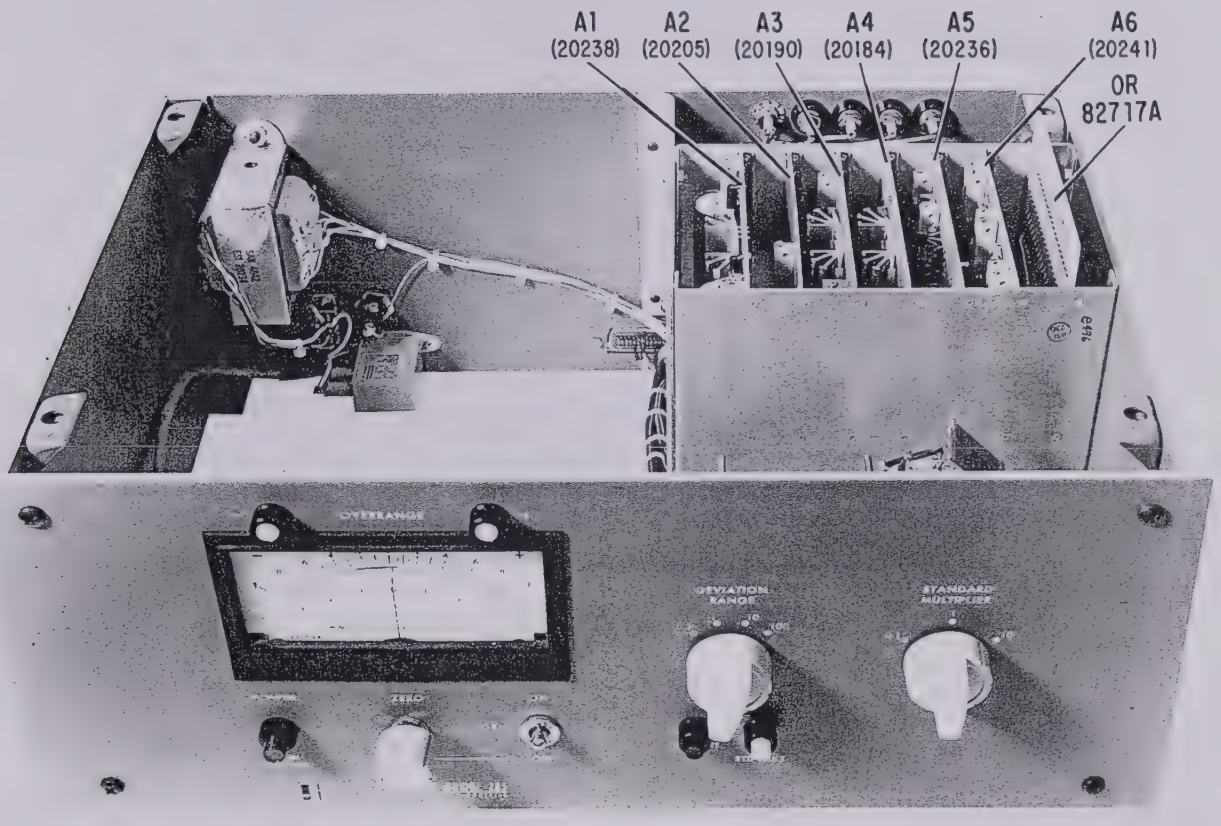


Figure 6-1. Circuit Assembly Location

6.3.2 Circuit Assembly Removal and Replacement

The correct method of removing circuit assemblies is shown in Figure 6-2.

Grip the card firmly and pull *straight* out. To replace, slide the card into the track, pressing firmly until the top is even with or just below the level of the case.

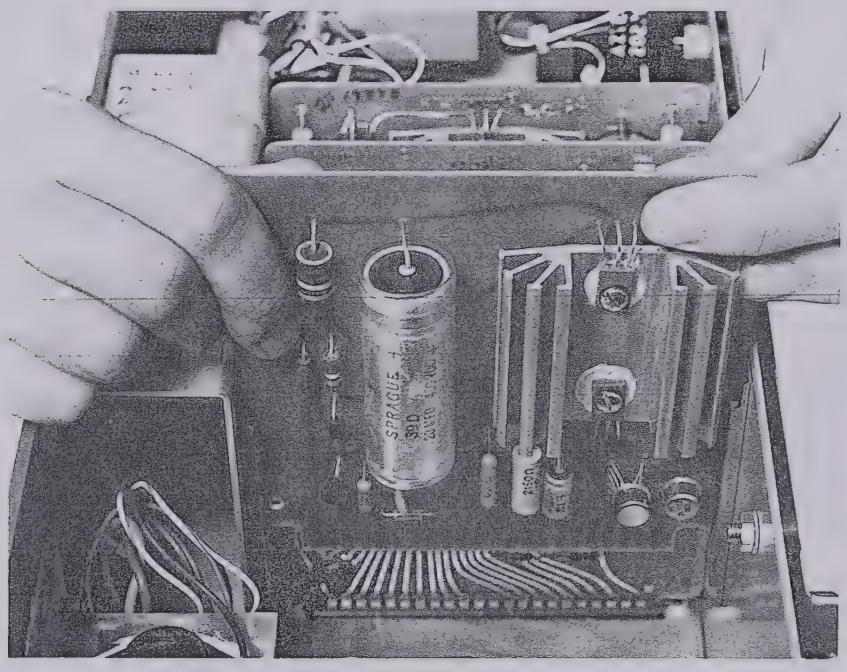


Figure 6-2. Removal of Circuit Assembly

6.4 REPLACING THE COVERS AND CASE

Be sure that the interior of the unit is completely clear of all foreign material. Replace dust cover, tightening all fasteners. Slip the unit back into the cabinet, replace all connections previously removed and replace the four mounting screws.

6.5 REPLACEMENT PARTS LIST

The following parts list is in alphanumerical order of the circuit reference designator. Miscellaneous parts are included at the end of the list. Manufacturer of the part is given as a code number according to the Federal Supply Code for Manufacturers (see list of manufacturers below).

Parts manufactured by Electro Scientific Industries must be ordered from the factory. When ordering, include the following information:

Model and serial number of the instrument
Electro Scientific Industries part number
Circuit reference designator
Description of part

CODE LIST OF MANUFACTURERS

01121	ALLEN-BRADLEY COMPANY, Milwaukie, Wisconsin
11537	SARTRON, INC., Newburg, Oregon
11837	ELECTRO SCIENTIFIC INDUSTRIES, INC., Portland, Oregon
12697	CLAROSTAT MANUFACTURING COMPANY, INC., Dover, New Hampshire
17851	RFI, INC., Carpinteria, California
22666	COMPONENT ENGINEERING CO., Chicago, Illinois
70903	BELDEN CORPORATION, Chicago, Illinois
72619	DIALIGHT CORPORATION, Brooklyn, New York
75915	LITTELFUSE, INC., Des Plaines, Illinois
76854	OAK MANUFACTURING CO., Chicago, Illinois
82389	SWITCHCRAFT, INC., Chicago, Illinois
95146	ALCO ELECTRONICS PRODUCTS, INC., Lawrence, Massachusetts

CKT REF	DESCRIPTION	MFR CODE	MFR PART NUMBER	ESI PART NUMBER	QTY USED
A1	Ckt Assy, ±15 V Regulator	11837		20238	1
A2	Ckt Assy, E or I Program, 8 V Supply	11837		20205	1
A3	Ckt Assy, Voltage-Current Amp	11837		20190	1
A4	Ckt Assy, R_X Gen	11837		20184	1
A5	Ckt Assy, Det & Overrange Comparator	11837		20236	1
A6	Ckt Assy, 60 Hz Integrating Filter	11837	202	20241	1
DS1,DS2	Lamp, 14 V, White, OVERRANGE	72619	507-3914-0375-600	13697	2
DS3	Lamp, 14 V, Green, PERCENT	72619	507-3914-14721600	13699	1
DS4	Lamp, 14 V, Amber, OHMS x STD MULT	72619	507-3914-1473-600	13698	1
DS5	Lamp/Switch, POWER ON/OFF	76854	616-26-A1H-100	18418	1
F1	Fuse, 1.5 A, 125 V	75915	31201.5	20280	1
R17	Potentiometer, 100 kΩ, 10 Turns, ZERO	12697	62JA-100K	18414	1

CKT REF	DESCRIPTION	MFR CODE	MFR PART NUMBER	ESI PART NUMBER	QTY USED
R18,R19	Resistor, 68 Ω, 1/2 W, 10%	01121	EB6801	12167	2
R20	Resistor, 2.2 kΩ, 1/2 W, 10%	01121	EB2221	1957	1
R21	Resistor, 47 kΩ, 1/4 W, 10%	01121	CB4731	13941	1
S1	Switch, Line Voltage Selector	82389	46206LF	18424	1
S2	Switch, GEN ON/OFF	95146	206N-MSTG	19093	1
S3	Switch Assy, DEVIATION RANGE	11837		20208	1
S4	Switch Assy, STANDARD MULTIPLIER	11837		20207	1
T1	Transformer, Power	11537	3-19V	20234	1
U1	Meter	11837		13004	1
	Cable, Interconnecting, to Limits Comparator	11837		21341	1
	Cable Set, Interconnecting, to Standard	11837		20246	1
	Cap, Binding Post, Gold	11837		1172	2
	Cap, Binding Post, Gray	11837		1476	8
	Connector Board	11837		82717A	1
	Filter, Line	17851	2B4	20282	1
	Fuse Holder	75915	342012	3074	1
	Knob, Small Round	11837		1472	1
	Manual, Maintenance	11837		20165	1
	Power Cord	70903	17258-B	13178	1

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Final calibration of this instrument was performed with reference to the mean values of the ESI reference standards or to ratio devices that were verified at the time and place of use.

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2. One year for components and instruments using active circuitry (see ESI Metrology Catalog). Six months for repairs of out-of-warranty items.

During the in-warranty periods, we will service or, at our option, replace any device that fails in normal use to meet its published specifications. Batteries, tubes and relays that have given normal service are excepted.

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There is a complete bibliography of ESI technical publications on the opposite side of this page. Underline the titles or order numbers of any publications you would like us to send. If there is any information that you would like to have, or if there is any comment you would like to make concerning the instrument or instruction manual, please fill out this page.

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(Please Print)

Name _____ Title _____

Department _____ Mail Stop _____

Company _____

Address _____

City _____ State _____ Zip Code _____

Any comments or corrections? _____

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